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REVIEW ARTICLE

Edible Insects as a Future Sustainable Food Source – Review

Dessalew Birlew Ayalew[1], Biresaw Demelash Abera[1,*]

[1]Faculty of Chemical and Food Engineering, Bahir Dar Institute of Technology, Bahir Dar University, Bahir Dar 6000, Ethiopia

ABSTRACT

In 2020, there were 7.8 billion people on the planet, and by 2050, it is predicted that there would be more than 9 billion. The existing food production must therefore be doubled to accommodate the growing population. The wide category of the arthropod phylum includes a class of organisms called insects. They are one of the most diverse groups of animals on the planet and have thereby inhabited practically all of its regions, from the poles to the tropics, and from lofty mountains to deep caverns. Insects that can be eaten are a significant, naturally occurring source of protein that can help to ensure enduring food security. However, a consumer's willingness to accept edible insects as food relies significantly on their region, eating habits, past knowledge, age, gender, and religion. Promoting the use of insects as a novel cuisine by raising awareness of the nutritional, health, and environmental advantages, processing to fully hide insect presence, and creating products that closely resemble meat and other foods would undoubtedly increase global insect consumption. Continuous use of resources has a huge impact on the environment and causes unsustainability in the future. Therefore, searching for alternative sources of food, especially proteins such as edible insects could be the best solution. This review focuses on the history, production, processing methods, nutritional composition, health benefits, risks, and future uses of edible insects.

Keywords: Edible insect; Entomophagy; Food Security; Green House Gas; Novel Food; Sustainability.

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Corresponding Author:
Biresaw Demelash Abera, Faculty of Chemical and Food Engineering, Bahir Dar Institute of Technology, Bahir Dar University, P.O. Box 26, Bahir Dar, Ethiopia.
Email: chembires@gmail.com

1. Introduction

According to estimates, the world's population will rise from 7.8 billion in 2020 to about 9.8 billion by 2050 (Mesterh & Ol, 2020), causing a 70% increase in food consumption and a rise in food costs. This population growth is one of the root causes of the world's food insecurity. The need for affordable, sustainable protein sources will grow as food prices rise. Inadequate food production and distribution, climate change, and the enormous problems posed by a growing world population all contribute to food and nutrition insecurity on a global scale (Kinyuru *et al.*, 2015). According to projections, changes in dietary habits would cause an increase in the consumption of animal products of 60 to 70% by 2050, particularly in developing nations (Kinyuru *et al.*, 2015). An environmentally acceptable method of raising food for consumption and promoting global food security is entomophagy, which is the term for the practice of humans eating insects (Hlongwane *et al.,* 2020).

Entomophagy is the consumption of insects as food. The word is derived from the Greek words "entomos," which means insects, and "phagein," which means, "to eat" (Pal & Roy, 2014). Although entomophagy is practiced in many nations worldwide, it is mostly found in Asia, Africa, and Latin America. Around two billion people consume insects as a supplement to their diets in the world and this has always been the case (Pal & Roy, 2014); ants, grasshoppers, bees, wasps, crickets, and other insect species are all edible. There are more than 1400 bug species that can be eaten worldwide (Odongo *et al*., 2018). Around 164 insect species are mass-collected and sold in Bangkok markets and supermarkets, for example, where eating insects is particularly popular in Thailand (Pal & Roy, 2014). Some edible insects are comparable in nutritional value to meat and fish, while others have a higher concentration of proteins, fats, and energy (Siulapwa *et al*., 2012). The protein composition of edible insects ranges from 35.34% for Isoptera (termites) to 61.32% for Orthoptera, taking into account the average contents of the insect (crickets, grasshoppers, locusts)(Rumpold & Schlüter, 2013).

Entomophagy has the potential to significantly reverse the trend of malnutrition and other nutritional deficiencies as well as enhance overall food and nutrition security, especially in the developing countries that are most severely affected (Kinyuru *et al.,* 2015). Only honeybees, cochineals, and silkworms have been domesticated despite the fact that people have employed insects for a variety of purposes for many thousands of years. This has likely multiple causes, including biological, historical, and cultural factors. The majority of edible insects are now collected from the wild, and insect farming for human consumption has only lately started. In Thailand, Laos, Vietnam, and Cambodia, crickets are being raised for food (Jansson & Berggren, 2015). In the first ten years of the twenty-first century, the Netherlands must be regarded as the "center" of early research on the human consumption of insects in Europe (Mancini *et al*., 2022). The main aim of this review is to report the types of common edible insects used as food sources, their nutritional compositions, perceptions of the world’s people about them.

2. Overview of Edible Insects

2.1. History of Edible Insects

Insects have been around for at least 400 million years, making them among the oldest terrestrial animals in our diverse world (A. van Huis *et al.,* 2015). People first began eating insects almost 7000 years ago (Dobermann *et al*., 2017).According to Paleontological research (A. van Huis *et al.,* 2015), insects were a part of early humans' diet. Because bugs have sufficient proteins, lipids, and micronutrients, the early hunters and gatherers relied on them for survival (Suthar *et al.,* 2020). Native Americans who roasted them over coals and then ate them like popcorn devoured June bugs (Srivastava *et al.*, 2009).They consumed cicadas as well, cooked in salt and garlic (Srivastava *et al.*, 2009).Throughout Southeast Asia and the African continent, termites have been historically consumed and ancient Romans and Greeks also consumed insects as part of their diets (Suthar *et al.,* 2020).

Insect consumption is a deliberate element of the diet for about 80% of the world's population (Dunkel & Payne, 2016). In China, records of individuals regularly consuming insects date back around 3000 (Feng *et al.,* 2018). In 11 European, 14 Oceanian, 23 American, 29 Asian, and 35 African nations, insects are eaten (Melgar-Lalanne *et al*., 2019). Mexico, China, Thailand, and India were found to be the top consumer nations and to have the greatest number of species (Nitharwal *et al.,* 2022). In the United States, insect farms had been established for a very long time by the 1940s, following World War II (Nitharwal *et al.,* 2022).

In Africa, eating insects has existed for as long as the continent itself. According to Raheem *et al*. (2019), the continent is home to the greatest diversity of insects, with over 1500 different species which include caterpillars (Lepidoptera), termites (Isoptera), grasshoppers, crickets, ants, and bees (Hymenoptera), as well as bugs (Heteroptera and Homoptera), beetles (Coleoptera), and locusts with their respective % (Table 1). Some of the most common edible insects are shown in Figure 1 below. The most often ingested insect order across the continent varies significantly, despite the fact that practically all African nations practice entomophagy. The Democratic Republic of the Congo, Congo, Cameroon, the Central African Republic, Zambia, Zimbabwe, Nigeria, and South Africa are the top countries in Africa that eat insects (Mariod, 2020).

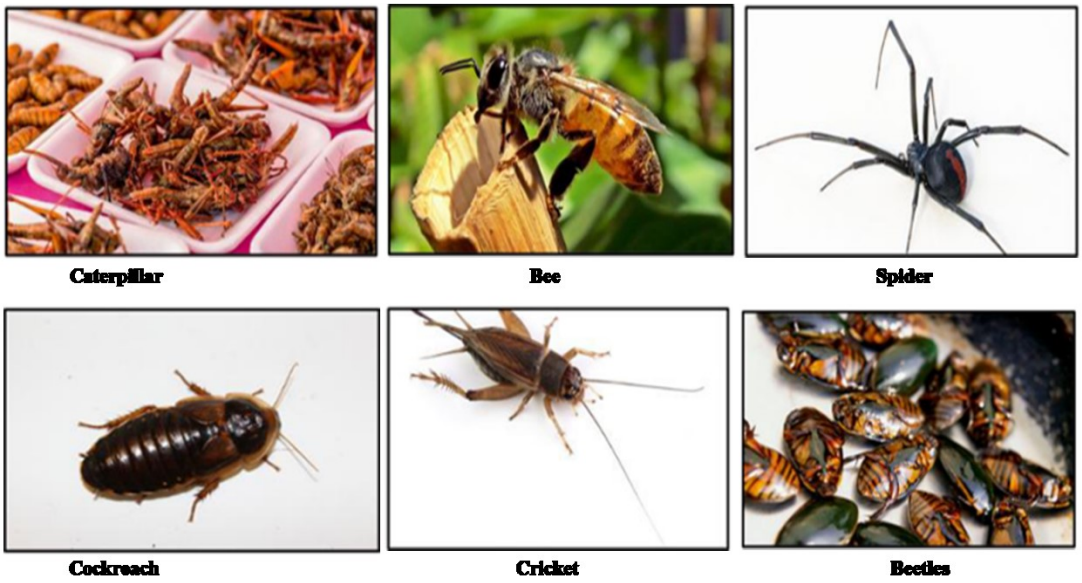


Figure 1: Pictures of some common types of edible insects (Adopted from: *Suthar et al., 2020)*

The Jews and Christians were urged by the Old Testament to eat grasshoppers, beetles, and locusts (Guynup, 2004). Insects are used as food and animal feed both historically and currently in West Africa (Dobermann *et al*., 2017). Traditional healers have also utilized insects as a form of medicine to treat illnesses in both people and animals. In 2008, Dutch businesses began producing insects for human consumption as part of an effort to promote entomophagy (Shelomi, 2015). An international symposium on the topic of entomophagy was held in May 2014 and was sponsored by the UN's Food and Agriculture Organization and Wageningen University (Suthar *et al.,* 2020).

2.2. Production/Farming of Edible Insects

Around 92% , 6% and 2% of edible insects in the world were captured and harvested from the wild, 6% semi-domesticated and 2% farmed (Feng *et al*., 2018); an excessive harvest of wild insects could endanger the biodiversity of the environment and put some species in danger of going extinct. Therefore, to ensure insects continue to be a staple of the human diet, expanding insect farming is a crucial task. As public awareness of the benefits, edible insects have for the environment grows; insect farming has become more productive than other animals thanks to technological advancements (FAO, 2013b).

In many nations, primarily in Asia, commercial insect farms have been created; but, in Europe, edible insects have not yet established themselves as a competitive source of protein to rival conventional plant- and animal-based sources (Żuk-Gołaszewska *et al*., 2022). Thailand is a major producer of insects, with 20,000 farms producing about 7500 tonnes annually (Baiano, 2020). There are two ways to grow and breed insects for human consumption: either the insects are completely domesticated and raised in captivity, or they are partially raised in captivity while, often, remaining in contact with their wild populations (Feng *et al*., 2018);. Mealworms, cockroaches, and a few types of beetles are examples of fully domesticated insects. As opposed to that, the second category includes dragonflies, wasps, bamboo caterpillars, palm weevil larvae, and locusts (Baiano, 2020). Kenya, Tanzania, and Uganda all have

a number of companies that specialize in courtiers from eastern Africa; with the potential to become more automated systems as the market for edible insects expands in the area, over 95% of these farms currently function as microenterprises (Tanga *et al*., 2021). About 378 farmers in Kenya and 140 farmers in Uganda are working on Cricket farming for food and more than 30 tons of cricket powder is produced annually in these countries by small and medium-sized businesses (Magara *et al*., 2021).

2.3. Common Types of Edible Insects

Table 1: Types of Edible Insects

Order	**Species**	**%**
Coleoptera	Beetles	31
Lepidoptera	Caterpillars	18
Hymenoptera	Bees, wasps, ants	14
Orthoptera	Grasshoppers, locusts, crickets	13
Hemiptera	Cicadas, leafhoppers, planthoppers, scale insects, and true bugs	10
Isoptera	Termites	3
Odonata	Dragonflies	**3**
Diptera	Flies	2
Others	-----	5

Source: (Tuhumury, 2021)

The literature has identified around 1900 insect species as edible, the majority of which are found in tropical regions (Van Huis A, Van Itterbeeck J, Klunder H, 2013). As indicated in Table 1, beetles (Coleoptera) are the most consumed insect group (31%) followed by caterpillars (Lepidoptera), which are particularly popular in sub-Saharan Africa (18%), bees, wasps, and ants (Hymenoptera) (14%) (these insects are particularly common in Latin America); grasshoppers, locusts, and crickets (Orthoptera) (13%) and termites (Isoptera) (3%)(Van Huis A, Van Itterbeeck J, Klunder H, 2013).

In various parts of the world, including southern Asia where there are 351 edible species, bees, wasps, and ants are eaten (Feng *et al*., 2018); 50 species have been identified in China for use as food and medicine; of these, the nutrient contents of 35 species have been examined and larvae and pupae of both wasp and bees are the most frequently consumed edible insects for food in this region. The African food culture places a significant emphasis on edible insects (Mutungi *et al*., 2019). The most common insects, including Lepidoptera, Orthoptera, and Coleoptera, are caterpillars and termites (Kim *et al.*, 2019) ;in all, about 470 different species of insects are eaten.

There is an urgent need to create alternative meals in a world where 1 billion people go without food, the oceans and lands are overexploited, and the production methods are unsustainable; in this regard, insects are an excellent source of macro- and micronutrients as well as bioactive substances that may help prevent various human diseases and reduce nutritional insufficiency (Giampieri *et al*., 2022).

2.4. Nutritional Composition of Edible Insects

Edible insects offer high amounts of protein ,calories and also provide essential amino acids that people need (Churchward-Venne *et al*., 2017), but their nutritional values might differ depending on their metamorphic stage, environment, and die even within the same group of species . These are suitable for replacing grain protein; such amino acids include lysine, tryptophan, and threonine (Tuhumury, 2021). Protein from cereals, an important global staple meal, frequently lacks certain amino acids. Examples include a number of caterpillars, palm weevil larvae, and aquatic insects with lysine scores greater than 100 mg per 100 g protein (Tuhumury, 2021). Insects are also sources of fat and provide high monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) and minerals including zinc, iron, magnesium, phosphorus, manganese, and selenium (Zielińska *et al*., 2015). Additionally, considerable amounts of vitamins like riboflavin, biotin, pantothenic acid, and folic acid were found in insects (Zielińska *et al*., 2015).

According to Kim *et al.*, (2019), oils sourced from insects contain many PUFA. For instance, the 54% fat content of the African palm weevil (*Rhynhcophrus phoenicis*) included 38 % palmitoleic acid (MUFA) and 45 % linoleic acid (PUFA). In underdeveloped nations that are landlocked and have limited access to seafood, insects may be a significant source of polyunsaturated fatty acids like oleic, linoleic, and linolenic acid (Brogan, 2018). The mineral and vitamin composition of edible insects varies significantly between species and orders. Iron is well available in edible insects (Oonincx *et al.,* 2010). Many edible insects have an iron that is on par with or higher than that found in beef. As an illustration, the iron concentration of locusts and mopane caterpillars is 8-20 mg and 31-77 mg per 100 g, respectively, which is higher than in beef, which is 6 mg per 100 g (Oonincx *et al.,* 2010).

Edible insects are generally a cheap, very nutrient-dense source of animal protein and fat that is equivalent to milk, and meat proteins from insects are very easy to digest (between 77% and 98 %) (Vanitha *et al*., 2017). Low quantities of tryptophan or methionine and high levels of lysine and threonine are characteristics of the protein (Kim *et al.*, 2019). In comparison to cattle and pigs, it has a lower cholesterol level and a fat content that ranges from 7 to 77% (Dobermann *et al*., 2017). It is also rich in omega-3 and omega-6 fatty acids (Zielińska *et al*., 2015). Additionally, they contain more thiamine and riboflavin than whole wheat bread or an egg (Vanitha *et al*., 2017). Insects primarily have two types of carbohydrates: chitin and glycogen (Kim *et al.*, 2019). The former is a polymer of N-acetyl-D-glucosamine that makes up the majority of the exoskeleton, whereas the latter is an energy source that is kept in muscle and cell tissues (Kim *et al.*, 2019). The average amount of carbohydrates in edible insects range from 6.71% (Stinkbug) to 15.98% (Cicada) (Ojha *et al*., 2021) . Due to their high chitin content, which also has high Fe and Zn levels, insects can also serve as a source of fiber for vegetarians and pregnant women whose diets are deficient in these nutrients (Tuhumury, 2021). The nutrient composition of common types of edible insects is shown inTable2.

PJET, Vol. 1, No. 2, June 2023: 26-42
Poly Journal of Engineering and Technology
journal homepage : https://journals.bdu.edu.et/index.php/PJET/index
REVIEW ARTICLE

Table 2: Nutrient Composition of Edible Insects (Per 100 g Edible Portion).

Insects	Protein (g)	Fat(g)	CHO (g)	Fiber(g)	Fe(g)	Zn(g)	VitA (IU)	VitE (IU)	Energy (Kcal)	References
Lepidoptera	49-55	4-22	12-18	4-15	0.03-109	2-11	3.4-4.4	8.3-8.6	358-361	(Ruth Charrondière *et al.*, 2013)
Coleoptera	1-19	1-3	78-155	5-7	0.3-24	5-6	8-27	0.7-1.2	78-155	Toti *et al.* (2020)
Orthoptera	13-68	1-43	1-5	2-10	0.1-42	4-13	21-25	1.0-2.3	89-227	(Zielińska *et al.*, 2015)
Hymenoptera	7-14	3-13	5-6	1-3	3-103	4-15	-	-	79-184	(Ruth Charrondière *et al.*, 2013)
Hemiptera	19-20	2-57	3-8	4-5	0.4-29	4-6	21-150	1.4-13	63-165	Toti *et al.* (2020)
Isoptera	21-22	2-42	20-21	5-6	0.1-31	4	3-8	0.3-0.7	93-535	Toti *et al.* (2020)

PJET, Vol. 1, No. 2, June 2023: 26-42
Poly Journal of Engineering and Technology
j o u r n a l h o m e p a g e : https://journals.bdu.edu.et/index.php/PJET/index
REVIEW ARTICLE

2.5. Processing Methods of Edible Insects

Depending on the species, the guts, wings, legs, and heads of edible insects are removed first, and then the body is washed in cold water to remove the superfluous matter and unappealing parts (Mutungi *et al*., 2019); this method is called pre-processing method of edible insects. There are several types of traditional or conventional processing methods of edible insects to use them as a human food source such as sun drying, boiling, blanching, frying, freezing and roasting/toasting (Mutungi *et al*., 2019). According to Rumpold & Schlüter (2013), who compared the nutritional composition of about 200 edible insects, preparation and processing techniques like drying, boiling, or frying used before consumption might have an impact on nutritional composition. Therefore, a proper processing method of edible insects should be taken into account.

There are three basic ways that edible insects might be sold: whole (dried, frozen, or pre-cooked); processed; and extracted (Ojha *et al*., 2021). Insects can be processed into powder or paste, which can then be added to culinary products or used directly in recipes made by consumers (Ojha *et al*., 2021). In general, every edible insect processing method might be divided into three steps: gathering and pre-processing; decontamination (blanching, cooking/boiling, steaming, marinating, drying, smoking, toasting, and their combinations); and packing and storing (Nyangena *et al*., 2020).

2.6. Potential Benefits of Edible Insects

Ecology and human health may both benefit if edible insects are incorporated into human diets. It is possible to save resources like land and water, lower greenhouse gas emissions, and address difficulties with food security by replacing other animal and plant feeds with edible insects (Lange & Nakamura, 2021) . Edible insects like house cricket have a nutritious profile similar to that of plant and animal meals like pork, chicken, and beef ;they include appropriate amounts of vital amino acids, unsaturated fats, fiber, vitamins, and minerals, such as vitamin B_{12}, iron, zinc, and calcium (Di Mattia *et al*., 2019). Eating edible insects may improve gastrointestinal health, boost immunological function, lower the risk of bacterial infection, and even lessen chronic inflammation, which has been linked to cancer and cardiovascular disease, according to the nutrient profile of these creatures (Nowakowski *et al*., 2022).

The antioxidant capacity of crickets, grasshoppers, silkworms, African caterpillars, and evening cicada is two to three times higher than that of orange juice or olive oil (Di Mattia *et al*., 2019). Insects that can be eaten may also help lower blood pressure (A. Van Huis, 2020). The majority of food-related greenhouse gas (GHG) emissions are produced through the manufacturing of animal products (72-78% of the total agricultural emissions) (Springmann *et al*., 2018). A change in diet is necessary to minimize GHG emissions, as the respiration and metabolism of insect species emit far fewer GHGs than those of conventional livestock. Even the lowest members of society, such as women and landless workers, can raise and harvest insects with low-tech equipment and no capital input. Lowest-cost proteins are obtained via insect farming, at 40–75 g per 100g of the dry weight of insects (Nitharwal *et al.,* 2022).

Insect powders could be utilized as a dietary protein supplement for resistance training based on the nutrients they contain in order to increase muscle protein synthesis and hence increase muscle mass (Nowakowski *et al*., 2022). In Europe, the potential for using insects as a novel food source has recently received a lot of interest due to their nutritional and environmental benefits, which make them a promising and sustainable source of animal protein (Orsi *et al.,* 2019).

Numerous researches have revealed that mealworms have a mildly nourishing quality and no harmful effects when consumed (Son *et al*., 2020). Furthermore, the fact that mealworms can be produced in large quantities is one of the key benefits of using them as a food source. It can thrive in a small space and is adaptable to a variety of environmental factors. The mealworms also have good sensory qualities with a crispy texture and a flavor that is quite delicious and reminiscent of dried shrimp (Son *et al*., 2020).

2.7. Potential Hazards of Edible Insects

The risks associated with eating edible insects by humans must be taken into account, just like with any other animal- or plant-based meal (Kouřimská & Adámková, 2016). There have been reports of anaphylactic shock and moderate allergic reactions related to consumption of insects including caterpillars, silkworms, and cochineal (Belluco *et al.,* 2013). Those who are allergic to shellfish or sensitive to tropomyosin may experience an increased risk of an allergic reaction if they consume house crickets and other insects that contain this protein (Fernandez-Cassi *et al.,* 2018). There has been little research on the transmission and consequences of these germs from eating insects in people, despite the possibility that some insects, such as houseflies and beetles, can carry potentially dangerous bacteria (Belluco *et al.,* 2013). Home crickets can be properly processed by boiling, blanching, chilling before roasting or toasting for eating, or frying them first to limit and prevent the presence of microbiota like Listeria, Bacillus, and Clostridium, which are frequently sequenced from house crickets (Fernandez-Cassi *et al.,* 2018).

2.8. Potential Factors Influencing Consumption of Edible Insects

There are a number of factors that affect the consumption of edible insects in various communities as presented below.

Emotional responses: The thought of entomophagy can elicit a range of emotions, and there are various psychological hurdles that prevent many people from accepting eating insects. The two primary psychological reasons why people reject eating insects as food are frequently identified as neophobia and revulsion (Trigo *et al.,* 2020). The term "food neophobia" is used to characterize a person's propensity to avoid trying new foods (Mascarello *et al*., 2020). The bulk of studies examining consumers' acceptance of insects, therefore, entails measuring the degree of food neophobia (Orsi *et al.,* 2019).

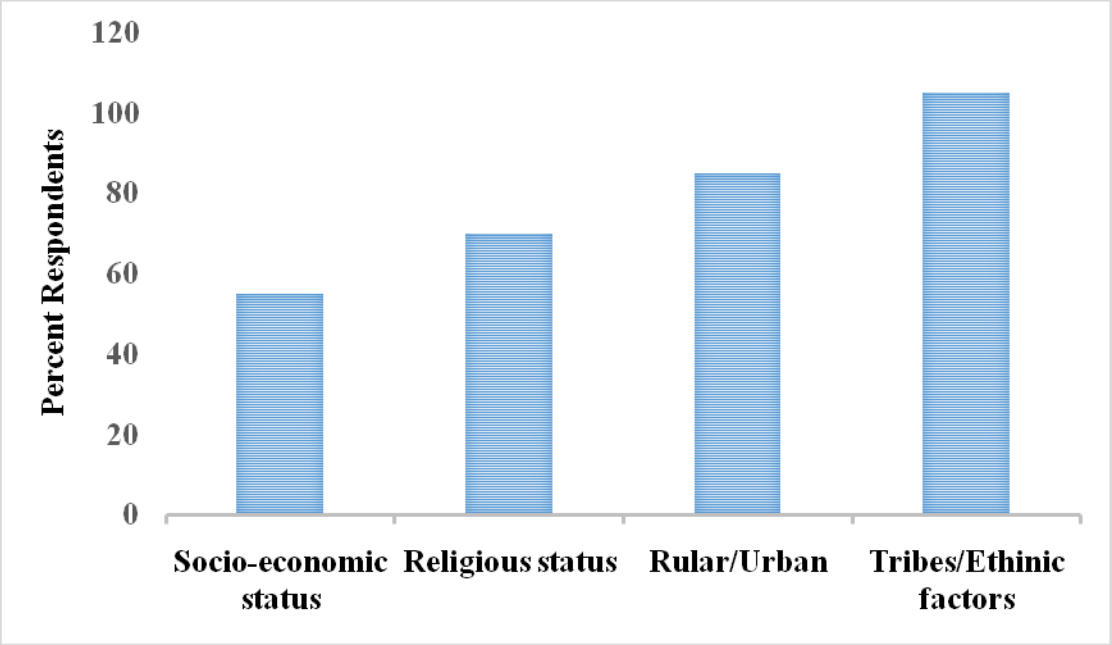
Social and cultural norms: The most prevalent explanations for consumers' experiences of disgust have been shown to be social and cultural factors. In addition to evolving over time, what is considered edible is also defined and negotiated in social and cultural contexts. This is also closely related to "food taboos" which are situations in

which particular foods are not allowed in a given cultural context (Wendin & Nyberg, 2021). As Manditsera *et al*., (2018) reported, the liking for and consumption of insects can be significantly influenced by religion. According to their religion, consuming edible insects is strictly forbidden for about 21.7% of urban respondents and 8.7% of respondents in rural areas; however, 6.1% of respondents in urban areas and 22.1% of respondents in rural areas report that their faith influences their choice of edible insects to eat (Manditsera *et al*., 2018).

Knowledge and education: Although the majority of customers are aware that insects and larvae can be eaten, many also think that doing so is unhealthy (Florença *et al.*, 2021) .The lack of information about the value of alternative protein sources in the human diet as well as the best practices for cooking and preparing dishes with insects is a significant deterrent to the consumption of edible insects (Gedrovica, 2019).

Familiarity and the importance of exposure: Growing familiarity has frequently been cited as a means of fostering acceptance and reducing neophobia because most Westerners are unfamiliar with eating insects. Reducing neophobic reactions and testing insects as food may boost acceptability by reducing neophobic reactions (Wendin & Nyberg, 2021).

Unfamiliarity with eating insects as food may also be a barrier to market growth and consumption, particularly in societies where eating insects is not customary. In particular, neophobia and the organoleptic characteristics of edible insects in comparison to other well-known foods (such as meat and legumes) are viewed as significant barriers to consumer acceptability. Previous research proposed pairing invisible insects with enticing flavors or incorporating them into meal preparation to address these concerns (Roma *et al.*, 2020). In light of this situation, it is essential to apply a thorough consumer-oriented strategy to investigate the elements driving entomophagy at the same time and to offer general insights into its spread (Roma *et al.*, 2020). As shown in Figure 2, ethnic factors had the highest percentage and greatest influences on edible insect consumption trends while socioeconomic factors had the least in percentage among other factors.



Source: (Kelemu, 2014)

Figure 2: Socio-Cultural Factors Influencing Edible Insects.

2.9. Edible Insects in the Future

Global demand for meat is rising, and the limited amount of land that is accessible leads to a search for alternative protein sources (Van Huis & Oonincx, 2017). Even the sustainability of meat production is being questioned right now. Edible insects are fascinating in terms of low greenhouse gas emissions, high feed conversion efficiency, low land use, and even the possibility of transforming low-value organic side streams into high-value protein products, in addition to being a substitute protein source for human food and animal feed (A. Van Huis, 2016). These characteristics of insects directly encourage the need to eat them in the near future (Patel *et al.,* 2019).

Insects can grow on organic wastes such as animal feces or plants that are inedible to humans and animals, which essentially implies that they do not compete with human food sources and this can help to reduce environmental pollution in the future (Raksasat *et al*., 2020). As a result, we can soon anticipate seeing insect-based products on the shelves of supermarkets. Therefore, if we want edible insects to become a common food source in the future, attention should be paid to existing farming practices as well as technologies that can handle the rising demand (FAO, 2013b).

Currently, great attentions in Africa have been given to edible insects; Professor Monica Ayieko of Jaramogi Oginga Odinga University of Science and Technology works with Kenyan research organizations to promote insect awareness in academic settings and at the national level in Kenya (FAO, 2013a). Several institutes on possible future sources of food are being established in Africa such as pan-African institution for research and development, the International Centre of Insect Physiology and Ecology situated in Nairobi, Kenya to develop and expand

management tools and strategies for both harmful and beneficial arthropods. This will help to reduce poverty, ensure food security, and improve the general health of people living in the tropic (FAO, 2013a).

Thus, in the near future, tropical nations may include edible insects as a significant component of their daily diet (a novel source of protein), directly contributing to the fight against a number of global concerns, particularly malnutrition and food insecurity (Suthar *et al.,* 2020).

2.10. Edible Insects in Ethiopia

In Ethiopia, edible insects have also been practicing in different part of the country. The most common type of trends using edible insects as a food source is the larva of honey. According to our best of knowledge, there is no a published paper, which gives a scientific evidence on edible insect consumption trends in Ethiopia. However, the above statement has been mentioned regarding our best of trends in different local areas.

3. Conclusion

Entomophagy is one of the possible solutions to the expanding nutrient needs of the world since edible insects can offer high levels of proteins, lipids, vitamins, and minerals with significant economic and environmental benefits. For the world's expanding population, they represent a promising alternative supply source of protein for human beings. Edible insects are becoming more and more popular as food. They are also eaten for the purpose of entertainment. The use of edible insects, however, raises concerns about potential safety and health risks unless consumed in appropriate way.

There are several kinds of processing methods of edible insects to use as a food or incorporate with food; such as blanching, toasting, frying, freezing, and drying. There are many reasons why edible insects have not been practicing well in the world. In some regions of the world, eating insects as food comes with some religious and psychological restrictions, such as a sensitivity to revulsion, the dangers of doing so, and a willingness to try new foods. In general, edible insects are an interesting protein food source and attracting the global world because of the vast variety of insect species with a high nutritional value, easier production process, affordable production costs, high availability, and an environmentally friendly that involves to a reduction of greenhouse gas emissions.

Future studies on the safe consumption strategies of edible insects, processing methods, legislation, and regulatory measures, and the way to change consumer perceptions of accepting edible insects as a food source have to be conducted. There is no scientific paper on edible insects in Ethiopia; so research has to be done on the ethical, psychological and cultural acceptance level and consumption trends of insects in Ethiopian context. Research communities and agricultural products processing companies has to be created a strong engagement on the possible and future sustainable sources of food in the world. The government and other stakeholders have also be involved seriously on it.

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